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(54) Title of the Invention: Method of Abrasive Cleaning of Pipe Inner Surface and Apparatus for the Same

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(72) Inventor: Kinzo FUJII
1151-1, Aza Higashi-Kiryo, Oaza Shimada,
Tenpaku-cho, Tenpaku-ku, Nagoya-Shi

(71) Applicant: Kinzo FUJII
1151-1, Aza Higashi-Kiryo, Oaza Shimada,
Tenpaku-cho, Tenpaku-ku, Nagoya-Shi

DESCRIPTION

1. TITLE OF THE INVENTION

Method of Abrasively Cleaning Pipe Inner Surface and Apparatus for the Same

2. CLAIMS

(1) A method of abrasively cleaning an inner surface of a pipe in which an abrasive cleaning material is moved inside piping together with air sucked by sucking the inside of the piping to be abrasively cleaned with an air sucking apparatus from an end of the piping to be abrasively cleaned by a pressure difference between both ends in order to abrasively clean the inner surface of the pipe.

(2) A method of abrasively cleaning an inner surface of a pipe in which an abrasive cleaning material is moved inside piping by a pressure difference between both the ends of piping to be abrasively cleaned whose one end is pressurized and the other opposite end is caused to be a negative pressure so as to clean the inner surface of the pipe.

(3) The method of abrasively cleaning the inner surface of the pipe as claimed in claim (1) or (2), wherein a vacuum pump is employed as the air sucking apparatus.

(4) The method of abrasively cleaning the inner surface of the pipe as claimed in claim (1), wherein a blower

is employed as the air sucking apparatus.

(5) The method of abrasively cleaning the inner surface of the pipe as claimed in claim (1), wherein an apparatus whose power source is high-pressure fluid is employed as the air sucking apparatus.

(6) The method of abrasively cleaning the inner surface of the pipe as claimed in claim (1), wherein an apparatus for collecting the abrasive cleaning material and a material generated and adhered to the inner surface of the pipe is used between the sucking apparatus to be used and piping to be abrasively cleaned.

(7) The method of abrasively cleaning the inner surface of the pipe as claimed in claim (1) or (2), wherein cracked ice cubes are used as the abrasive cleaning material.

(8) The method of abrasively cleaning the inner surface of the pipe as claimed in claim (1) or (2), wherein stone chips are used as the abrasive cleaning material.

(9) The method of abrasively cleaning the inner surface of the pipe as claimed in claim (1) or (2), wherein silica is used as the abrasive cleaning material.

(10) The method of abrasively cleaning the inner surface of the pipe as claimed in claim (1) or (2), wherein water is used as the abrasive cleaning material.

(11) The method of abrasively cleaning the inner surface of the pipe as claimed in claim (1) or (2), wherein a material of the piping to be abrasively cleaned is steel.

(12) The method of abrasively cleaning the inner surface of the pipe as claimed in claim (1) or (2), wherein a Nash pump is used as the air sucking apparatus.

3. DETAILED DESCRIPTION OF THE INVENTION

Technical Field

The present invention relates to a method of abrasively cleaning inner walls of pipes, such as a water pipe and a gas pipe, and is especially effective to abrasively clean inner wall surfaces of existing piping, such as buried piping and piping in a building. Conventionally, as a method of abrasively cleaning the inner surfaces of the pipes, the following methods have been often used. For example, many chemical-cleaning methods have been used in which chemicals, such as for example, hydrochloric acid are injected into piping to be abrasively cleaned so as to dissolve and remove scale which is generated and adhered to the inside of the piping to be abrasively cleaned. However, it is difficult to completely remove the scale by this method. Further, it needs a lot of efforts to treat the effluent so that it needs a large amount of costs. On the other hand, a method has been developed in which sand together with high-pressure gas, such as high-pressure air and nitrogen is forced by pressure into the piping to be abrasively cleaned through one end of the piping to be

abrasively cleaned in order to abrasively clean the inside of the pipe, which is a sandblast method, and its effect is highly esteemed. In this method, however, when treating by means of high-pressure air, for example, four or five 100 H.P. compressors are required in order to abrasively clean a 125 mm diameter pipe, so that there are disadvantages that it needs a large amount of costs including compressor cost, a truck, a fuel cost, etc. a large temporary installation space and causes environmental disruptions such as noises, etc. and that since the high-pressure air is used, if the compressed air is not dehumidified, a good abrasive cleaning effect is not acquired. The piping, which needs the abrasively cleaning, is often an old pipe which has been laid down for several years. The high pressure is applied to the inside, so that an accident may happen, it may explode or the sand etc. moving inside the piping may damage a human body or a building.

The present invention provides a method of abrasively cleaning an inner surface of a pipe, which overcomes the disadvantages as mentioned above in the conventional methods and is safe, reliable, pollution-free, as well as inexpensive.

Hereafter, with reference to the drawings the present invention will be described in detail. In Fig. 1, (1) denotes piping to be abrasively cleaned, which is like

a water pipe or a gas pipe laid underground or inside a building, and is piping having many bent portions and branch portions on its way. In order to implement the present invention in such piping, joints near both ends of piping to be abrasively cleaned etc. are removed in advance, so as to provide openings (15) and (16). A temporary piping (4) for sucking an abrasive cleaning material is connected to one opening (15). A container (3) loaded with abrasive cleaning materials (2), such as cracked ice cubes and crushed stones are provided at a tip of the piping (4). Further, the other opening (16) is provided with an air sucking apparatus (8), such as a blower or a vacuum pump, through apparatuses (5) and (5') which collect the abrasive cleaning material and the generated and adhered material discharged from the abrasively cleaned piping. Operation of this air sucking apparatus (8) produces a pressure difference between the openings (15) and (16) of the piping to be abrasively cleaned (1). Then, the abrasive cleaning material (2) loaded on the container (3) is sucked together with the air from the end of the temporary piping (4), and moves together with an abrasive cleaning material (2') towards the opening (16) at a high speed inside the piping to be abrasively cleaned (1), while abrasively cleaning scales (A), such as rust which has been generated and adhered to the pipe. A mixture (B)

of scale (A) and the abrasive cleaning material (2') which are sucked and discharged from the opening (16) is separated in the recovery apparatus (5). Then, micron dust which cannot be removed is passed through water pooled in the recovery apparatus (5') so as to be collected completely. Only the cleaned air is discharged from an air outlet (9) through the air sucking apparatus (8). When the scale (A) is no longer discharged from the opening (16), the abrasive cleaning is ended. Next, an example of the present invention will be described.

Example 1

As shown in Fig. 3, water supply was turned off beforehand to the water distributing pipe which was made of cast iron, had been laid under a public road for 15 years, and was a 100 mm bore diameter piping to be abrasively cleaned, which was cut into a portion of 200m length, and opening (15) and (16) were prepared. Usually, sand, ice, steel, and mineral matter could arbitrarily be used as the abrasive cleaning material, however, commercially available No. 4 crushed stones were used this time. As shown in Fig. 6, a service vehicle (13) in which a root blower and a scale recovery apparatus were mounted on a 4t truck was used as the air sucking apparatus. As to capacity of the root blower used for

air suction this time, its power was 66 H.P., its airflow rate was 85 m^3/min., and its static pressure was 6,000 mmAq. In addition, the scale (A) had the rust as the principle component and a thickness of about 25 mm, so that it was generated and adhered to the whole circumference of the piping to be abrasively cleaned (1). When the service vehicle (13) was operated without drying the inside, the No. 4 crushed stones as the abrasive cleaning material (2) supplied to the container (3) in advance were started to be sucked together with the air from the opening (15), then traveled together with the air inside the piping to be abrasively cleaned (1), and were discharged together with the scale (A) through the opening (16) to the scale recovery apparatus (5). At this time, a speed of the abrasive cleaning material (2') moving inside the piping to be abrasively cleaned was a flow rate of 70 m/sec. When 5 minute had passed after operation, the scale (A) was no longer discharged, so that the operation was stopped, and the inside of the abrasively cleaned piping was visually inspected via the openings (15) and (16). Since the scale was completely removed and the inner surface of the cast iron pipe was exposed, so that the operation was completed. The mixture (B) of the abrasive cleaning material (2) and the scale (A) which was discharged at this time was measured to give 1,278 kg. Subtracting 90 kg, a weight

of the crushed stones or the used abrasive cleaning material (2), from the measured one, the discharged scale was 1,188 kg. Note that, if a 200 m pipe having a diameter of 100 mm is subjected to treatment by means of the conventional sandblast method as mentioned above, then as shown in Fig. 2, two air compressors (10) (10') having power of 200 H.P. and providing an air flow rate of 17 m^3/min. - 20 m^3/min., and a pressure of 7 kg/cm^2 which were mounted on a 4.5t truck as a pressure source for transferring by pressure, a sandblast apparatus (11), and four garbage trucks (12) are used, at first only using the air in the piping to be abrasively cleaned (1), ventilation is carried out for 1 hour to 2 hours, the sand is forced by pressure to move and it needs 30 minutes to one hour to remove the scale (in order to remove water for drying, if sand as the abrasive cleaning material is directly used without removing the water, the sand in a ball-shape adheres onto the scale).

Example 2

As shown in Fig. 5, a water supply pipe made of SGP in a 5-story building which was 10 years old since its construction had bore diameters of 32 mm at the branch pipe portion on the opening (15) side and 100 mm at the main pipe on the opening (16) side and a total length 170 m including ten 15 m branch pipe portions (subtotal:

150 m) and the 20 m main pipe. The joints etc. at both ends were removed, the operation and suction were carried out through the openings (15) and (16) by means of the service vehicle (13) as described in Example (1), thus the operations were ended. The time required for the operations was a short time of a total of 2 hours and 30 minutes including 1 hour for preparation, 30 minutes for the operations, and 1 hour for tiding. In addition, No. 3 silica was used as for the abrasive cleaning material.

As described above, according to the method of the present invention, the operations can be carried out without problem with efforts to treat waste fluid due to chemical cleaning or water pollution by chemical washing, without impairment of the abrasive cleaning effects by the sandblast method, or without using many temporary hoses (14) and many apparatuses, as is clear from comparing Fig. 2 with Fig. 3 and Fig. 4 with Fig. 5. Therefore it has a feature that it can be installed in a small space so that when construction is performed on a public road, a hazard to moving traffic can also be set to the minimum. Since it can be constructed without pulling about many temporary hoses or noise pollution, it has the feature that the time necessary for completion can also be shortened considerably and can be constructed cheaply. Moreover, the greatest

merit is that since the operations are carried out with a negative pressure for the piping to be abrasively cleaned, the piping is not affected by pressure at all unlike a pressurizing method. According to the method of the present invention as described above, it has the outstanding feature that, irrespective of the diameter size of the piping, unless the scale is adhered to only a space through which fluid, such as abrasive cleaning material and sucked air, may pass, the operations can be carried out, and the sandblast apparatus required for the sandblast method is not required at all. Although a No. 4 crushed stones and No. 3 silica were used for abrasive cleaning materials in the above examples, if they can pass through the piping to be abrasively cleaned, it is not necessary limited to them.

For example, when the scale (A) generated and adhered to the piping to be abrasively cleaned (1) is a soft material like water stain, even if the water with the air may be sucked and caused to travel as the abrasive cleaning material, the abrasive cleaning effects can be provided. When using the cracked ice cubes as abrasive cleaning materials, even if they are blocked within the pipe, they melt into water over time, so that it can be discharge easily. Moreover, the air sucking apparatus used as the blower this time, however it can be a vacuum pump or an apparatus which employs high-pressure fluid

as the power source as shown in Fig. 7. Moreover, it may be pressurized through the opening (15) and sucked from the opening (16).

4. BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a flow chart for illustrating an embodiment for implementing a method according to the present invention.

Fig. 2 and Fig. 4 show examples of operations a pressurization sandblast method performed conventionally.

Fig. 3 and Fig. 5 show an example when implementing the method of the present invention.

Fig. 6 shows an example of an apparatus as recited in claim (6) of the present invention.

Fig. 7 shows an example of an air sucking apparatus which employs high-pressure fluid, such as gas and water, as a power source as recited in claim (5).

(A)....scale generated and adhered to inside of pipe
(B)....discharged mixture of abrasive cleaning material and scale
(1)....piping to be abrasively cleaned
(2), (2')....containers for loading abrasive cleaning material
(5), (5'), (5''), (5''')....scale recovery apparatuses

(6), (6')....connection piping

(7)....water for micron dust filtration

(8)....apparatus for air suction

(9)....air outlet

(10), (10')....air compressors

(11).... sandblast apparatus

(12)....dust collector

(13)....service vehicle equipped with air sucking apparatus and scale recovery apparatus

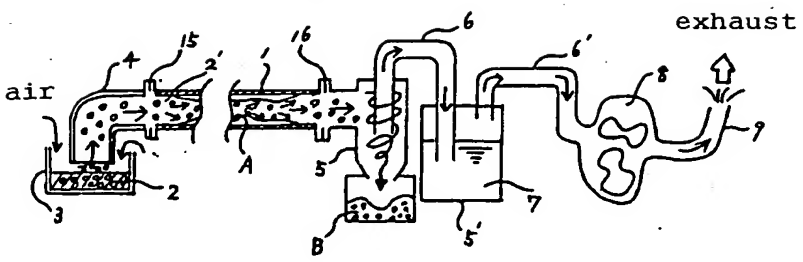
(14)....temporary hose

(15), (16)....openings

(17)...ring-like nozzle chamber

(18)...main body of air sucking apparatus which employs high-pressure fluid as power source

才1図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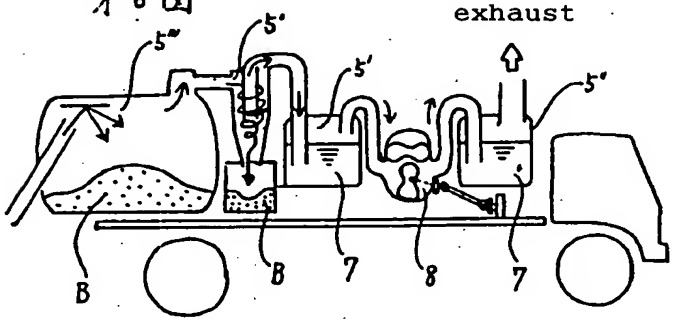
16
6
6'
8
9
A
5
2
3
B
5'
7

才6図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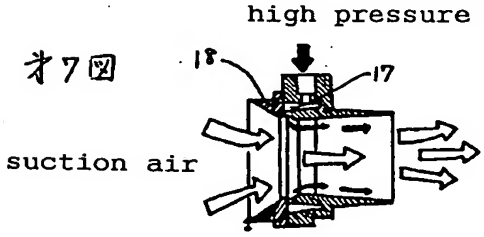
才7図


high pressure fluid
18
17
suction air

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（全 5 頁）

⑤4パイプ内面の研掃方法及その装置

⑳特　　願　昭56—102546
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㉑発 明 者　藤井金蔵
名古屋市天白区天白町大字島田字東寄鷲1151番地の 1

㉑出 願 人　藤井金蔵
名古屋市天白区天白町大字島田字東寄鷲1151番地の 1

明　細　書

1. 発明の名称

パイプ内面の研掃方法及びその装置

2. 特許請求の範囲

(1) 被研掃配管の一端より空気吸引装置にて被研掃配管内部を吸引することによって両端間の圧力差により吸い込まれた大気とともに研掃材が配管内部を移動しながらパイプ内面を研掃することを特徴とするパイプ内面の研掃方法。

(2) 被研掃配管の一端より加圧し反対側の一端を負圧にすることによって被研掃配管の両端間の圧力差により研掃材が配管内部を移動しながらパイプ内面を研掃することを特徴とするパイプ内面の研掃方法。

(3) 特許請求の範囲(1)(2)に使用する空気吸引装置として真空ポンプを用いて行うことを特徴とするパイプ内面の研掃方法。

(4) 特許請求の範囲(1)に使用する空気吸引装置としてブロワを用いて行うことを特徴とするパイプ内面の研掃方法。

(5) 特許請求の範囲(1)に使用する空気吸引装置として高圧流体を動力源とする装置を使用することを特徴とするパイプ内面の研掃方法。

(6) 特許請求の範囲(1)において使用する吸引装置と被研掃配管の中間に研掃材及びパイプ内面付着生成物を回収する装置を使用することを特徴とするパイプ内面の研掃方法。

(7) 特許請求の範囲(1)(2)に使用する研掃材として氷塊を使用することを特徴とするパイプ内面の研掃方法。

(8) 特許請求の範囲(1)(2)に使用する研掃材として石塊を使用することを特徴とするパイプ内面の研掃方法。

(9) 特許請求の範囲(1)(2)に使用する研掃材として硅砂を使用することを特徴とするパイプ内面の研掃方法。

(10) 特許請求の範囲(1)(2)に使用する研掃材として水を使用することを特徴とするパイプ内面の研掃方法。

(11) 特許請求の範囲(1)(2)における被研掃配管の材質が鋼製である事を特徴とするパイプ内面の研掃方法。

(12) 特許請求の範囲(1)(2)に使用する空気吸引装置としてナッシュポンプを用いて行うことを特徴とするパイプ内面の研掃方法。

3. 発明の詳細な説明

本発明は水道管やガス管などのパイプ内壁面の研掃方法に関するもので埋設配管や建物内配管等既設配管内壁面の研掃に特に効果のあるものである。従来パイプ内面の研掃方法としては以下述べるような方法がよく用いられている。即ち被研掃配管内へ例えば塩酸のような薬品を注入して被研掃配管内に付着生成したスケールを溶解除去する化学洗浄法が数多く用いられてきた。しかしながらこの方法にて完全にスケールを除去するのは困難であり、さらにはその廃液処理に手数がかかりそれにともない多額の経費が必要であった。又一方被研掃配管の一端より高圧空気やチッ素等の高圧ガスとともに砂を被研掃配管の内部に圧送してパイプ内面を研掃する方法すなわちサンドブラスト法が開発されており、その効果は高く評価されている。しかし当該方法では例えば高圧空気にて施工する場合、φ125ミリのパイプを研掃するには100馬力のコンプレッサーが4台～5台必要でありそれにともないコンプレッサー代、運搬費、燃料費等、多額の経費と広い仮設場所さらには騒音など公害の原因にもなり又高圧空気を使用するので圧縮された空気を除湿しなければ良い研掃効果が得られないという欠点がある。研掃を必要とする配管は多くは布設後数年を経た老旧管であるが内部に高圧を加えるため破裂したり又、その際配管内を送行中の砂などが人体や建物を損傷するという事故も起きている。

本発明は以上にのべた従来方法の欠点を克服し安全確実、無公害、さらには安価にパイプ内面の研掃を施す方法を提供するものである。

以下図面によって本発明の詳細について説明する。第1図においては(1)は被研掃配管である。これはたとえば地中や建物の内部に布設された水道管やガス管のようなもので途中において多数の曲りや分岐部を有する配管である。このような配管において本発明を実施するには予め被研掃配管の両端付近の継手等が外されて開口部(15)(16)が設けられている。その一方の開口部(15)には研掃材吸入用仮設配管(4)が接続されその先端には氷塊や砕石等研掃材(2)を挿填した容器(3)が設置されている。又もう一方の開口部(16)には研掃材及び被研掃配管より排出された付着生成物を回収する装置(5)(5)を介してブロワや真空ポンプのような空気吸引装置(8)が設置されている。この空気吸引装置(8)を運転すると被研掃配管(1)の開口部(15)(16)の間に圧力差を生じる。そうすると仮設配管(4)の先端より容器(3)に挿填された研掃材(2)が大気とともに吸引され被研掃配管(1)の内部を開口部(16)の方向へ研掃材(2)とともに管内に付着生成した錆などのスケール(A)を研掃しながら高速で移動して行く。開口部(16)より吸引排出された研掃材(2)とスケール(A)の混合物(B)は回収装置(5)の中で分離しそれで取りきれないミクロンダストは回収装置(5)の中にためてある水の中を通らせて完全に回収しきれいになった空気のみ空気吸引装置(8)を介して排気口(9)より排出させる。開口部(16)よりスケール(A)が排出されなくなった時点で研掃は終了する。次に本発明の実施例を示す。

実施例1.

第3図の如く公道に埋設された布設後15年経た鋳鉄製水道配水管　口径φ100㎜の被研掃配管を予め断水し長さ200mに切断し開口部(15)(16)を設けた。通常研掃材は砂、氷、鋼、鉱物質のものが任意使用できるが、今回は市販されている4号砕石を使用した。空気吸引装置は第6図のようにルーツブロワとスケール回収装置を1台の4tトラックにセットした作業車(13)を使用した。この時空気吸引用として使用したルーツブロワの能力は動力66HP、風量　8.5㎥／㎞、静圧－6000㎜Aqであった。尚被研掃配管(1)には錆を主成分とするスケール(A)は約約

２５㎜の厚みで円周全体に付着生成していた内部を乾燥させずに作業車(13)を運転すると容器(3)に予め投入してあった研掃材(2)である４号砕石を開口部(15)から大気とともに吸引しはじめ、被研掃配管(1)の中を空気とともに走行し、開口部(16)をへてスケール(A)とともにスケール回収装置(5)に排出された。この時被研掃配管の中を移動する研掃材(2)の速度は、流速７０ｍ／secであった。運転後５分たった時点でスケール(A)が排出されなくなったので運転をとりやめ開口部(15)及び(16)から被研掃配管内部を目視にて検査したがスケールは完全にとりさられ鋳鉄管の地肌が出ていたので作業を完了した。この時排出された研掃材(2)とスケール(A)の混合物(B)を検量したら1,２７８Kgあった。これから使用した研掃材(2)である砕石９０Kgを差し引くと排出されたスケールは1.１８８Kgであった。参考までに先述した従来行われているサンドブラスト法で１００㎜のパイプ２００ｍ行うとすれば第２図に示すように圧送用加圧源として4.5ｔ車に架装した動力２００HP、風量１７㎥～２０㎥／min、圧力７Kg／㎠のエアーコンプレッサー(10)(10)２台、サンドブラスト機(11)さらには集塵車(12)の４台を使用して、まず被研掃配管(1)の中の(水分をきり乾燥させるために水分をきらずにいきなり研掃材である砂を使用するとスケールの上に団子状に付着する)のみで１時間～２時間通風したあと砂を加圧圧送しスケール除去に３０分～１時間の時間を要していた。

実施例２.

第５図のごとく建設後１０年経た５階建ビルのＳＧＰ製水道給水管　口径は開口部(15)側の枝管部がφ３２㎜開口部(16)側の本管は１００㎜長さは枝管部が１５ｍが１０本計１５０ｍ本管が２０ｍの合計１７０ｍであった。両端の継手等を取りはずし開口部(15)(16)をへて実施例(1)に使用した作業車(13)にて運転吸引し作業を終了した。作業に要した時間は段取り時間１時間　作業時間３０分後片付けに１時間の合計２時間３０分のわずかな時間であった。尚 研掃材は3号硅砂を使用した。

以上述べたように本発明による方法によれば化学洗浄による廃液処理の手数や水質汚濁の問題もなくサンドブラスト法による研掃効果をそこなわず第２図と第３図、第４図と第５図の対比でもよくわかるように多くの仮設ホース(14)や多数の機材を用いることなく施工でき、このためのメリットとして狭い設置場所ですむため公道上で行う工事の場合は交通障害も最少限におさえることができ騒音公害や多数の仮設ホースも引張り廻すことなく施工出来るため、工期も大巾に短縮でき安価に施工できるという特徴をもっている。又一番のメリットは被研掃配管に対し負圧にて施工するので加圧する方法とちがい配管への圧力による影響が全くない。以上本発明による方法によれば配管径の大小にかかわらず研掃材と吸引された空気等の流体が通るだけのスペース分スケールが付着していなければ施工可能という優れた特徴をもちサンドブラスト法には必ず必要なサンドブラスト機も全く要らない。以上の実施例において研掃材は４号砕石と３号硅砂を用いたが被研掃配管を通るものであれば必ずしもこれに限定しなくてもよい。

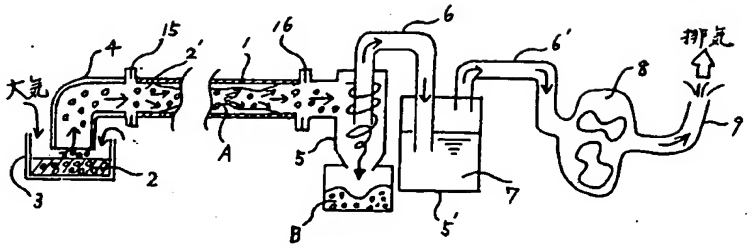
例えば被研掃配管(1)に付着生成したスケール(A)が水アカのようなやわらかいものであれば研掃材として水を大気と共に吸引走行させても研掃効果は得られる。研掃材として氷塊を使用すれば万一管内に詰った場合でも時間とともに溶解水となるので簡単に排出できる。又空気吸引装置も今回はブロワを使用したが真空ポンプや第７図に示すような高圧流体を動力源とした装置でも差しつかえない。又開口部(15)から加圧し開口部(16)から吸引しても良い。

4.　図面の簡単な説明

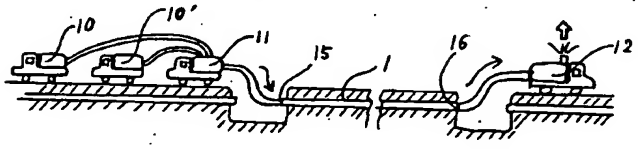
第１図は本発明による方法を実施する態様を例示するフロチャート。第２図は第４図は従来行われている加圧サンドブラスト法の施工例。第３図、第５図は本発明の方法を実施するさいの１例である。第６図は本発明の特許請求の範囲(6)に記載した装置の１例である。第７図は特許請求の範囲(5)に記載したガスや水等の高圧流

体を動力源とした空気吸引装置の1例である。(A)は管内に付着生成したスケール(B)は排出された研掃材とスケールの混合物(1)は被研掃配管(2)(2')は研掃材挿填用の容器、(5)(5')(5'')(5''')はスケール回収装置、(6)(6')は連絡配管、(7)はミクロンダストろ過用の水、(8)は空気吸引用装置、(9)は排気口、(10)(10')はエアーコンプレッサー、(11)はサンドブラスト機、(12)は集塵機、(13)は空気吸引装置とスケール回収装置とをセットした作業車、(14)は仮設ホース、(15)(16)は開口部、(17)はリング状ノズル室、(18)は高圧流体を動力源とした空気吸引装置本体

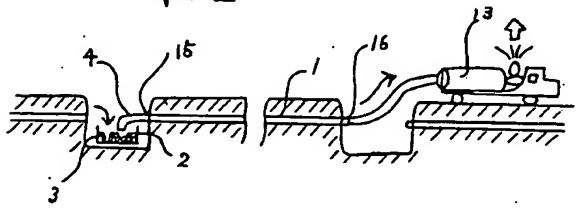
第1図

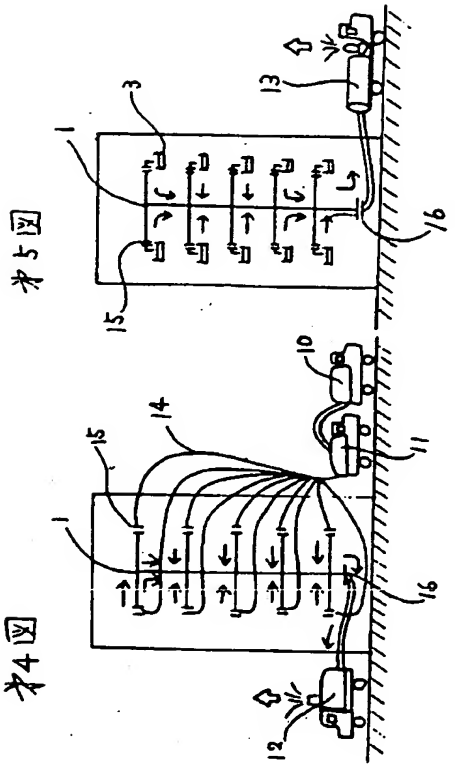


第2図



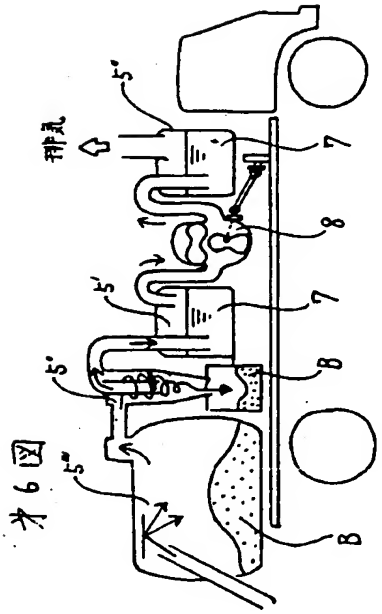
第3図



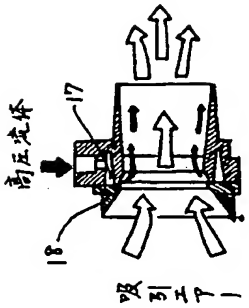


第5図

第4図



第6図



第7図